Specialisation and asymmetries in the macroeconomic fluctuations: evidence for the European regions

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Specialisation and asymmetries in the macroeconomic fluctuations: Evidence for the European regions (*)

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Specialisation and asymmetries in the macroeconomic fluctuations: Evidence for the European regions(*)¶

Abstract

This article examines the hypothesis that there is an inverse relationship between specialisation in production and the symmetry of cyclical fluctuations in the regions of Europe. In so doing, an index of asymmetries for the cyclical fluctuations of per capita GDP in the regions of Europe is constructed and various geographical patterns are reported. From the sample, the Mediterranean regions show the highest levels of asymmetry. In addition, an econometric analysis of the determinants of the asymmetries in regional fluctuations is carried out. The results show the significance of specialisation in production as a determinant of asymmetries in the regions and the importance of the geographical location of a region in accounting for its level of asymmetry. Furthermore, regions whose neighbours show highs levels of asymmetry tend to show similarly high levels of asymmetry.

Key words: regional specialisation, business cycles, economic integration, risk sharing, spatial econometrics

JEL classification: E32, F15, F43

1. INTRODUCTION

The construction and future expansion of the European Economic and Monetary Union have renewed academic interest in the analysis of the effects of monetary integration. Many of the studies conducted in this field have taken Robert Mundell's seminal paper (MUNDELL, 1961) in which he outlines his Theory of Optimum Currency Areas, as their analytical frame of reference. In this theory, Mundell claims that monetary integration generate both costs and benefits for the participating economies.

The theory stresses that the fact of belonging to a currency area – which reduces the transaction costs generated by the existence of an exchange risk – will promote the international exchange of goods and services. If we add the fact that belonging to a currency area may mean that regions will now share a consistent monetary policy over time which tends to favour price stability as opposed to a hypothetical alternative based on the use of a discretionary monetary policy for each of them, these two aspects (growth in trade and macroeconomic stability) would favour the growth of output in the participating economies.

But Mundell's study also notes the existence of potential costs incurred from the fact of belonging to a currency area. This can be seen as the loss of an instrument of economic policy that might help maintain a certain control over the economic cycle. For this reason, only those countries that show a high degree of symmetry in their cyclical behaviour will enjoy benefits that outweigh costs by belonging to a currency area. Only they, therefore, will be candidates for forming part of an optimum currency area.

In adopting this framework of analysis, various studies have sought to evaluate the importance of different arguments concerning the benefits generated by belonging to a monetary union. Thus, ROSE (2000), FRANKEL and ROSE (2002) and ALESINA and BARRO (2002) have demonstrated the existence of a significant, positive correlation between belonging to a common currency area and the volume of bilateral country trade. ALESINA and BARRO (2002), in addition, have shown the existence of a direct relationship between a greater volume of trade and an increase in the growth rate of the economies in the union.

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In evaluating the costs incurred from belonging to a currency area, studies initially sought to identify which countries showed the greatest synchrony in their cyclical behaviour and, therefore, the greatest probability of forming part of an optimum currency area (ARTIS and ZHANG, 1999).

However, various studies have called into question the exogeneity of the criteria proposed by Mundell when identifying which countries appeared, *a priori*, as candidates for forming part of an optimum currency area. Thus, FRANKEL and ROSE (1998) pointed out that entry into a currency area increases trade between member countries. In these circumstances, two opposing effects may arise: first, the economic cycles of the participating economies may come closer together, thus reducing the hypothetical costs incurred by the loss of the monetary instrument; but at the same time their productive specialisation is likely to rise, thus increasing the differences between the economic cycles.

For this reason, in fact, FRANKEL and ROSE (1998) proposed a new means of analysing the costs resulting from the processes of monetary integration. Since the publication of this study, the focus has tended to be on whether the monetary integration generates greater synchrony between the participating economies or not. Adopting this new approach, various authors have identified new ways in which economic integration in general, and monetary integration in particular, can affect the cyclical behaviour of the economies.

Thus, COE and HELPMAN (1995) have stressed that advances in the processes of economic integration stimulate the international diffusion of shocks in economic policy and improve the technological connections and the quality of the offer between the participating countries. Seen from this perspective, economic integration favours a greater synchrony in the cycle.

Authors such as KRUGMAN (1993), however, have stressed that the greater trade integration derived from monetary union stimulates the processes of specialisation in production, causing a reduction in the international correlation of the cycle. By contrast, as mentioned above, FRANKEL and ROSE (1998), and also ROSE and ENGEL (2001), highlight the fact that the growth in the volume of trade serves to strengthen

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existing connections of demand between the participants. As a result, the symmetry of the economic cycle should be greater following the process of integration.

Finally, FRANKEL and ROSE (1998) argue that, although this sequence of economic integration, specialisation in production, and increased international trade gives rise to theoretically disparate effects on the degree of symmetry of the economic cycle, the empirical analysis indicates that there exists a positive relation between the intensity of bilateral trade and symmetry in the economic cycle. In other words, the synchrony in the cycle increases with the processes of integration.

Similarly, KALEMLI-OZCAN **et al.** (2001) and (2002) highlight the existence of an additional mechanism linking economic integration and the cycle. They argue that, when the process of integration reaches the factors market, in particular the capital market, the existence of a means by which investors can establish strategies of international risk sharing favours a degree of specialisation in production that extends beyond that established by the various tariff barriers in operation, with effects on the synchrony in the business cycle.

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The theory underlying the argument is as follows: although the benefits derived from the processes of specialisation are widely agreed on, various authors have pointed out that specialisation in production can increase production variability (RUFFIN, 1974). In such conditions, a growing specialisation in production could lead to a loss in welfare for the economy that outweighs the benefits derived from the process of specialisation. As a result, a brake would be placed on the development of the processes of specialisation.

However, as has been pointed out by GROSSMAN and RAZIN (1985) and HELPMAN (1988), the integration of the capital markets opens up pathways via which it is possible to share the risk associated with a specialisation in production between the various regions and countries involved in the process of integration. The trade in securities ensures that the geographical concentration of production is compatible with the geographical diversification of the income generating sources in each region. Consequently, under such conditions of capital market integration, specialisation in production can grow as a result of a mechanism that is independent of the level of commercial integration. Given this situation, eventually, the synchrony in the business cycle may be affected.

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KALEMLI-OZCAN **et al**. (2001) and (2002) empirically test the existence of this dual relationship on a sample that includes the states of North America and a group of OECD countries. They confirm the existence of a positive relationship between international risk sharing and specialisation in production (KALEMLI-OZCAN **et al**., 2002). In addition, they also show how the greater specialisation achieved in this manner maintains an inverse relationship with the symmetry of the cyclical fluctuations through a mechanism of causation that appears independently of the commercial integration.[1] Therefore, the integration of the capital markets, if it generates mechanisms of international risk sharing, allows the furthering of the processes of specialisation, with significant effects on the degree of symmetry of the economic cycles of the participating economies.

Figure 1. Effects of economic integration on business cycle symmetry

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Figure 1, based on the work of KALEMLI-OZCAN **et al.** (2001) and HOFFMANN (2003), provides a summary of the principal effects on the degree of symmetry in the economic cycle caused by the processes of integration. The lower part of the graph seeks to illustrate the debate between the respective stances defended in such studies as FRANKEL and ROSE (1998), where it is held that economic integration increases trade and, hence, the synchrony, and those that identify the existence of additional effects. In the latter case, the studies of both KRUGMAN (1993) and KALEMLI-OZCAN **et al**. (2001) and (2002) describe the coexistence of two contrasting effects on the degree of symmetry. On the one hand, although they recognise that the greater specialisation in production favours trade growth and with it cyclical synchrony, they stress that this specialisation can generate a reduced degree of symmetry in the economic cycle, given that sector-specific shocks will have distinct effects on regions with highly diverse productive structures.

On this matter, there exists a debate, therefore, as to which of the effects prevails from an empirical perspective. The study presented here adopts this line of empirical analysis and focuses on a study of the countries and regions of Europe. In particular, we evaluate the existence of asymmetries in the business cycle among the European countries and regions and we analyse the existence of a relationship between the level of specialisation in production and the size of these asymmetries in the regional economic cycle.

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Unfortunately, the information available from REGIO relating to regional employment is only available up to the year 1996 and does not include the regions of some countries that now form part of the Eurozone, such as, for example, Austria and Finland. In view of this situation, it was decided to carry out the exercise with the entire sample of regions available, although this means including the regions of the UK and Denmark, countries which did not then go on to form part of the Eurozone. Therefore, the analysis that is presented is not a specific analysis of the asymmetries in the cycle and the productive specialization among the countries that adopted the euro as their common currency, a fact which should be interpreted as a limitation of the evidence presented in the study.

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The paper is organised as follows. In section 2, we construct an indicator of asymmetries for the European countries and regions. This presentation and study of the values recorded by the indicator allow us to identify the existence of a geographical pattern in these values, a pattern that cuts across state borders and a consideration of which can be important when conducting an analysis of its determinants. Section 3 presents an analytical exercise in which we study the existence of a relationship between the degree of specialisation in production and asymmetries in the productive cycle. In this exercise, we consider the influence of the position occupied by the regions in space by applying estimation techniques taken from spatial econometrics. Finally, section 4 highlights the main conclusions reached and discusses these in the context of economic policy proposals for the European Economic and Monetary Union.

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2. ASYMMETRIES IN THE CYCLE IN THE EUROPEAN REGIONS

The measure of asymmetry constructed and used in this study assumes that the typical consumer in each region suffers a potential loss of welfare due to the existence of asymmetrical fluctuations in GDP and the absence of international risk sharing mechanisms. In other words, the change from a scenario of financial autarky to one of perfect mobility of capital may generate gains in welfare since, at the limit, in the first case our individual's consumption possibilities are linked to the GDP of his region and, in the second, he will consume a fraction of the aggregate GDP of the regions under consideration. In these conditions, the size of the gain to be obtained by moving from a scenario of financial autarky to one of international risk sharing will be inversely linked to the degree of synchrony between the business cycle of a particular region and the mean business cycle of all the regions under consideration.

With this underlying idea, KALEMLI-OZCAN **et al.** (2001) demonstrate how a measure of asymmetry such as that suggested can be derived from a structural model. This, depending on the utility function proposed by the model, responds to a different final functional form, although the hypothesis underlying the different forms is the same.

Should the functional form proposed for the utility function be logarithmic, the indicator of asymmetry can be constructed in accordance with the following expression:

$$G^i = \frac{1}{\delta}\left(\frac{1}{2}\sigma^2 + \frac{1}{2}\sigma_i^2 - \mathrm{cov}^i\right)$$

where σ^2 is the variance in growth of the GDP per capita of the set of areas being studied in the given time period, σ_i^2 is the variance in growth of the GDP per capita of the region under analysis, cov^i is the covariance between these two series of growth rates and δ is a constant that describes the rate of discount. The hypothesis underlying the resulting formula is direct: the lower the covariance among the growth series of GDP per capita, the higher the indicator of asymmetry will be - a fact that points to the existence of a potentially higher gain for the region being analysed should there exist mechanisms that allow full international risk sharing.[2]

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Deleted: The measure of asymmetry constructed and used in this study parte de la idea de la existencia de una potential loss of welfare para el consumidor representativo de each region due to the existence of asymmetrical fluctuations in GDP and the absence of international risk sharing mechanisms. En otras palabras, el paso de un escenario de autarquía financiera a uno de perfecta movilidad de capital generaría unas ganancias de bienestar para éste derivadas de que, en el límite, en el primero de los casos sus posibilidades de consumo están vinculadas al GDP de su región y en el segundo este individuo representativo podría consumir una fracción del GDP agregado de las regiones consideradas. En estas condiciones, la dimensión de la ganancia que puede obtenerse por el paso de un escenario de autarquía financiera a uno de cobertura internacional de riesgo estará ligado de forma inversa al grado de sincronía existente entre el ciclo productivo de una región y el de la media de las regiones consideradas.¶

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When applying this formula to the sample of European regions, the indices were constructed with serial data of regional GDP per capita for the period 1981-1996. As for δ, in line with the proposal made by KALEMLI-OZCAN **et al.** (2001), we have adopted a rate of temporal discount equal to 0.02.

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The indicator of asymmetries was constructed for all those territorial units for which the REGIO database of EUROSTAT provides serial data of nominal GDP per capita for the EUR-12 countries. Specifically this meant, 12 countries, 59 NUTS-1 and 111 NUTS-2.[3] In Table 1 we present the values of the indicator of asymmetries for the 12 member states of the EUR-12, while in Map 1 we present the results obtained for this indicator at the maximum level of territorial breakdown possible, which oscillates between the NUTS-2 and the country.[4]

Table 1. Indices of asymmetry: Countries, 1981-1996

From an initial reading of the data a pattern appears to emerge. It can be seen how the countries of the Mediterranean basin present asymmetry indices that are higher than the mean value. This is the case of Portugal, Spain, Italy and Greece. Bringing up the rear in this classification are the countries of Central and Northern Europe (France, Germany, Belgium, Denmark and Holland). The intermediate levels are occupied by the United Kingdom. It seems, therefore, that a pattern is established as regards the size of the asymmetries at the state level with the countries of Northern Europe presenting values that are clearly below those recorded by the countries of the Mediterranean basin.

Map 1. Indices of asymmetry. 1981-1996

Map 1, also illustrating the period 1981-1996, summarises all the information obtained, and is presented at the highest degree of territorial breakdown permitted by the source. As can be seen, if the map is considered according to the values attained by the indicators of asymmetry at the regional level (NUTS-1 and NUTS-2), the general impression derived from Table 1 is maintained. The highest indicator values are recorded by the Italian, Greek, Spanish and Portuguese regions. The lowest values are recorded by the French and Dutch regions, although, here, a number of regions including Baden-Württemberg, Saarland and Nordrhein-Westfalen in Germany and Yorkshire and the Humber or North East in Britain record very low values. The intermediate values are found in various British, Belgian, German and even in some Dutch (Oost-Nederland) regions.

The regional evidence confirms the appearance of a geographical pattern in the distribution of asymmetries in the economic cycle. The Mediterranean regions tend to have higher indicators of asymmetry than those in Central Europe. The French, German, Dutch and Belgian regions record the lowest values.

In addition, an analysis of Map 1 allows us to see that, in most cases, the values recorded by the indicator of asymmetries tend to be similar for adjacent regions in the same country. Nevertheless, on occasions, marked differences are recorded between regions in the same state. Spain, Italy, Greece and Portugal provide paradigmatic examples of this, being countries in which there is a great diversity of regional behaviour, and in which there even appear cases of regions whose indicators of asymmetry share values with neighbouring regions in other states.

One hypothesis that would allow us to explain this type of behaviour is that, together with institutional factors that may be linked to the cycles of the regions in the same state, such as the existence of a common political cycle, it is determined by the existence of similarities in the relative factor endowments between geographically close countries and regions. Thus, the latter would tend to specialise in similar sectors and, should specific types of shock occur, the indicators of asymmetry would show, other things being equal, more similar values between adjacent regions.

This type of effect, that is those linked to specific lines of specialisation in production, are the ones considered by KALEMLI-OZCAN **et al.** (2001) in their empirical analysis of the determinants of the indicators of asymmetry through variables such as population size, relative weight of the agrarian sector or the energy sector. In the next section we shall examine the determinants that explain the value reached by the index of asymmetry in the European regions.

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3. ASYMMETRIES AND SPECIALISATION IN PRODUCTION

As discussed in the introduction, the analytical study seeks to verify the existence of a direct relationship between the specialisation in production of the European regions and the size of the asymmetries detected in the productive cycle. To do this, the study requires information of a regional nature concerning two basic variables: productive structure, which will allow us to construct the summary indicators of specialisation in production, and GDP per capita, a variable necessary for constructing the indicators of asymmetry. To obtain these data, we used the REGIO databases provided by EUROSTAT and the process of constructing the indicators was conditioned by the available information.

As for the indicators of asymmetry, in the previous section we have shown how it is possible to construct these for the EUR-12, although at different levels of geographical aggregations. Specifically, it has been possible to construct these indicators for 12 countries, 59 NUTS-1 and 111 NUTS-2.

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However, limitations concerning the availability of information impede the construction of regional indicators of specialisation in production for a part of EUR-12. Specifically, EUROSTAT does not provide a break down of information concerning productive structure at the level contemplated in this analysis - not at the regional level or even at the state level in the cases of Germany, the United Kingdom and Holland.

With these restrictions, therefore, the sample used in the econometric analysis comprised 91 observations, consisting of 76 NUTS-2 - for which we have serial information of the GDP per capita and the productive structure broken down to the level of 19 branches of production; 12 NUTS-1 - for which we have the same information, but not at the level of NUTS-2 which make them up; and, the three states for which we also have this information, although not at the level of breakdown corresponding to the NUTS-1 or the NUTS-2 that make them up.[5]

The coefficient of global specialisation for each of the regions examined in the study was calculated by applying the following expression:

$$SPECG_i = \sum_{s=1}^{S}\left(\frac{LAB_i^s}{LAB_i} - \frac{1}{J-1}\sum_{j\neq i}\frac{LAB_j^s}{LAB_j}\right)^2$$

where LAB_i^s (LAB_j^s) is the level of employment in sector s in region i (region j), LAB_i (LAB_j) is the total employment in region i (region j), S is the number of productive sectors considered and J is the number of regions studied. In the analysis below S has a value of 19 and J a value of 91.

The hypothesis underlying the resulting formula is the following: if region i had the same productive structure as the mean value for the regions studied, the indicator would have a value of 0 ($SPECG_i=0$), whereas as the more the productive structure of the region differs from that of the rest of the regions, the closer the coefficient of specialisation moves towards 2.

We also calculated a coefficient of industrial specialisation for each of the regions ($SPECI_i$). In this case, the formula used is the same as the one above with the exception that we only used the employment figures for the 11 industrial branches into which the industrial product is broken down.

Although the best alternative would have been to calculate the value of the indices of specialisation on a yearly basis and then to calculate a mean figure, the data available do not provide serial information for each year. Therefore we decided to compute them only for the middle year of the period studied, namely 1988, and to undertake our analysis with this information.

In the strategy of empirical testing, we tackled the potential problem of incomplete specification by adopting two measures. First, in the specifications we considered the use of a range of control variables proposed in the empirical literature. Thus, we conducted controls for the existence of different levels of specialisation in certain productive lines, such as that of industry, including a summary index of industrial specialisation as a control variable in the regression analysis. Likewise, taking into consideration the characteristics of the agrarian productive cycle - more irregular than that of the industrial, construction and services sectors, we examined the possibility that, all things being equal, the regions with the greatest weight in agrarian production as a share of total production would present the highest indices of asymmetry. In this case, we did not consider any differences in the internal configuration of the sector given that the database did not allow us to construct this type of index. Finally, as is common in such exercises, in conducting the estimates we sought also to control the size of the region being studied, with variables such as the size of the population and transformations in this population.

Therefore, the functional form proposed for testing for the existence of a positive relationship between the level of regional specialisation and the indicator of asymmetries in the productive cycle is of the type:

$$LASIM_i = \alpha + \beta\, LESPEG_i + \gamma\, LCONTROL_i + u_i$$

where LASIM is the logarithm of the value of the coefficient of asymmetry for each of the observations; LESPEG, is the logarithm of the coefficient of specialisation in production calculated for each of the regions and LCONTROL is the vector of control variables used in the analysis, expressed in logarithms. Specifically, in Tables 2 and 3, LESPECI refers to the logarithm of the coefficient of industrial specialisation and LAGRI to the logarithm of the weight of the agrarian sector in the productive structure of each of the regions.[6]

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Returning to the measures employed in tackling the problem of the incomplete specification, secondly, given the spatial regularities found for the endogenous variable, in the estimation process we were concerned to consider the position occupied by the various territorial units in space. In other words, we analysed whether the spatial distribution of the variables studied was merely random or whether it reflected a pattern of spatial auto-correlation or dependence. We opted to analyse this alternative for two reasons.

First, because the presence of spatial auto-correlation in the estimated equation would have serious consequences that might invalidate any conclusions obtained when applying the classic econometrics methodology (ANSELIN and GRIFFITH, 1988).

Second, from the perspective of the analysis of the determinants of the differences in the regional cyclical fluctuations, we might expect that, independently of the level of aggregate specialisation, neighbouring regions might specialise in similar productive sectors in a way that, when faced with sector-specific shocks, neighbouring regions might present similar indicators of asymmetry.

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The spatial variable could be demonstrating, independently of the level of aggregate specialisation, the importance of sector-specific shocks in the configuration of the indicator of asymmetry. However, we should not rule out the possibility that geographical proximity strengthens commercial ties and that the specifics of a region are transmitted to bordering regions more intensely.

In order to examine the presence of spatial auto-correlation in the variables under consideration, we first calculated the Moran I statistic and Geary's C statistic, which under the null hypothesis describe a random spatial distribution of variables.[7] To perform these calculations, we first needed to define a matrix of contacts (W) which shows the spatial interactions or dependencies between the different territorial units. This matrix indicates for each spatial element the subsets of elements among which there might exist mutually dependent relations. To carry out the analysis proposed in this article, we used a matrix of contacts based on the inverse distance between the capitals of each of the regions being considered.

Table 2 shows the results obtained.[8] When the null hypothesis of a random spatial distribution of the variables under consideration is rejected, it is found that the value attained by these variables in a region is affected by the value they attain in adjacent regions.

Table 2. Spatial autocorrelation tests

The values obtained from conducting these tests indicate that all the variables are spatially dependent. The results show that there exist relations of spatial interdependence between the regions under consideration, making it necessary to examine this non-random distribution in the series analysed by estimating the equations proposed for studying the determinants of the indicators of asymmetry.

In this sense, it should be pointed out that, in the regression models, spatial auto-correlation can adopt two forms. The first is what Anselin has called the model of spatial autoregression. In this case we can speak of a structural dependence, given that it appears when the value of the endogenous variable in an area is dependent on the values taken by this variable in neighbouring or nearby areas. The second form of spatial autocorrelation is the model of auto-regressive spatial disturbances, in which the spatial dependence is incorporated in the error term. For this reason we estimated the basic functional form proposed by OLS and we then tested for the presence of the spatial auto-correlation, either at the level of the endogenous variable or at the residual level.[9] To determine this aspect we ran the Moran I test and the test based on the principle of the Lagrange multipliers: LM-LAG (ANSELIN (1988b)) y LM-ERR (BURRIDGE (1980)).

Table 3 shows the results obtained in three sets of regression analyses: the first (columns 1 and 2) include two control variables, LESPECI and LAGRI. Columns 3 and 4 show the results of a model in which the weight of agrarian production is not included as a control variable. Columns 5 and 6, finally, present a model in which none of the control variables under consideration are included. The difference between the odd-numbered and the even-numbered columns is that the former show the results derived from an estimate of ordinary least squares while the latter are derived from a process of estimation of maximum likelihood in which a term of spatial correlation is included.

Table 3. Estimation results

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In the case of the three estimations by OLS, we can see that each of them presents a robust, positive relationship between specialisation and asymmetries. Furthermore, the significance levels are very high. In the regressions that include control variables, such as the weight of the agrarian sector and the coefficient of industrial specialisation, the sign recorded was as expected, while the levels of significance were high. Moreover, the contrasts based on the principle of the Lagrange multipliers require that the errors of the models estimated by OLS are normally distributed. This hypothesis of normality was tested using the Kiefer and Salmon test, and showed the normality of the model residuals estimated by OLS. In the models estimated we also calculated the Breusch and Pagan model, but it was not possible to reject the null hypothesis of the homoscedasticity of the sample in any of the cases.

However, when estimating the proposed model we rejected, in all cases, the null hypothesis of the absence of spatial dependence. The results obtained suggest that the spatial dependence is of a structural type. In other words, the value taken by the endogenous variable in an area depends on the value taken by this variable in neighbouring or nearby areas. Therefore, we estimated one more the auto-regressive spatial models using the method of maximum likelihood (Columns 2, 4, and 6).

As can be seen in each case, the results obtained using the two estimation procedures are similar, although in the estimations of maximum likelihood the value of the coefficient estimated for the specialisation index is lower than that obtained with the estimation by OLS. Furthermore, the values and the significance of the parameters related to the control variables fall markedly when incorporating the spatial correlation term when estimating the regression for maximum likelihood.[10]

By contrast, the robustness of the spatial variable estimates in the different specifications indicates the importance of the consideration of the spatial element in the regression analyses. In particular, the sign and magnitude of the estimated parameter λ indicate that the value reached by the asymmetry indicator in a region is influenced, positively, by the value reached by this indicator in the neighbouring or nearby regions.

If we examine the fall in values and the significance of the estimated parameters for the control variables in the regressions that incorporate the spatial element, we can state that the latter variable appears to reflect, independently of the level of aggregate specialisation, the importance of the sector-specific shocks in the configuration of the indicator of asymmetry. Finally, this might bear some relation with the control variables proposed in the literature, such as the weight of the agrarian sector and industrial specialisation, inasmuch as this type of variable can reflect the existence of relative specialisation in agrarian production or in industrial sectors that are intensive in labour or human capital and present similar values in the case of adjacent regions, with relatively similar factor endowments.

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4. CONCLUSIONS

This paper has tested the hypothesis of the existence of an inverse relationship between the specialisation in production of the regions of Europe and the symmetry of their cyclical fluctuations. In so doing, we have constructed an index of asymmetries of cyclical fluctuations in the regional GDP per capita and, then we have taken this to test for the existence of a relationship between the specialisation in production of the regions and this index.

In our quantification of the asymmetries, the study shows the existence of a geographical pattern in the cyclical fluctuations of the regions of Europe with the Mediterranean basin occupying the highest levels of asynchrony. By contrast, the central regions of France, Germany, Holland and some of the British regions present the highest levels of synchrony in the fluctuations of GDP per capita.

In addition, we have tested for the existence of an inverse relationship between specialisation in production and synchrony in the regional economic cycle. However, our study demonstrates that when tackling the problem of incomplete specification, a consideration of the control variables presented in the literature is insufficient. The existence of a spatial correlation between the variables under analysis means that this relationship is best considered using techniques drawn from spatial econometrics. On doing so, we confirmed the existence of a direct relationship between specialisation in production and the size of the asymmetries in a regression model in which the size of the asymmetries in neighbouring regions is significant in explaining the size of a region's asymmetries.

Some of the limitations of the study carried out have already been indicated in the introduction. In particular, it has been pointed out that the absence of statistical information for some regions of the Eurozone prevents the exercise carried out from being able to be understood as an evaluation in the strict sense of the potential benefits associated with the creation of EMU. This analysis would make it necessary, first, to study the changes recorded in the asymmetries of the regional economic cycle starting from the establishment of the single currency and, second, to identify its determinants. Indeed, this limitation opens up a line of work that will be developed in the future and that will make it possible to significantly enhance the nature of the research undertaken.

Deleted: In interpreting these findings, the study offers additional evidence to that presented by KALEMLI-OZCAN **et al.** (2001) and (2002) as to the existence of an effect caused by the processes of economic integration themselves. If, as has been demonstrated in the aforementioned study, a more complete integration of the capital markets offered by mechanisms of international risk sharing induces the specialisation in production to go further than that caused by the reduction in tariff barriers associated with the integration of capital goods markets, it is possible that this effect gives rise to greater asymmetries in the productive cycle. ¶
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The interpretation of this evidence, however, does not necessarily suggest the generation of greater costs for these regions as they face monetary integration. In fact, as the mechanisms of international risk sharing take root, the income received by the average individual in each of the regions should acquire greater stability, although the geographical distribution of production means that the regions experience greater asymmetries in the cycle.

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Footnotes

[1] However, they also note the fact that the evidence presented points to the existence of a Krugman effect involving commercial integration, specialisation and greater symmetries in the cycle.

[2] The algebraic derivation of the expression is in KALEMLI-OZCAN **et al.** (2001), pp. 130-135.

[3] Appendix 1 shows all the territorial units for which an indicator has been constructed, and the values recorded by each. Although we had GDP per capita data for subsequent years, we chose to terminate the study in 1996 as part of the information used in the following section was only available up to this year.

[4] This is the case of Denmark, Ireland and Luxembourg, countries for which serial data of GDP per capita are only available at this level of territorial breakdown.

[5] In Appendix 2 we list the 91 territorial units considered, as well as the branches of activity that make up regional production.

[6] It should be stressed that the analysis undertaken did not allow us to consider the dynamic components of the process that links the specialisation in production with the cyclical behaviour of the economies being studied. The information available at the regional level in Europe does not, for the time being, allow us to undertake this exercise.

[7] For an analysis of the techniques adopted in Spatial Econometrics see ANSELIN (1988a), ANSELIN and FLORAX (1995) and ANSELIN **et al.** (1996).

[8] In this and in the following table, the results referring to the control variables linked to the size of the region are not shown since on being incorporated into the model they were found not to be statistically significant.

[9] These statistics and the rest of the results obtained in this section have been calculated using the program: Space Stat. ANSELIN (1992).

[10] In performing the estimates we also considered the possible problem of endogeneity in the independent variables. In particular, from a theoretical perspective, we cannot rule out the possibility that specialisation is affected by asymmetries in the fluctuations of production. To settle this matter, we performed alternative estimations using instrumental variables in the empirical analysis. In the specifications in which the industrial specialisation index (LESPECI) is not included as a regressor, we used both the delayed values of this index (LESPEG) and the industrial specialisation index (LESPECI) as instruments of the aggregate index of specialisation (LESPEG). By contrast, in those specifications in which the industrial specialisation index is included as a regressor we used, as an instrument of the aggregate index of specialisation (LESPEG), values of this index corresponding to certain years. From the comparison made using the HAUSMAN test (1978) among the estimations performed by OLS and by instrumental variables, we were able to deduce that there was no problem of endogeneity in the exercise that was undertaken. In these conditions, and considering still the possibility that the instruments used were not the most appropriate, we decided to maintain the hypothesis of the non endogeneity of the variable relative to specialisation in production.

Figure 1. Effects of economic integration on business cycle symmetry

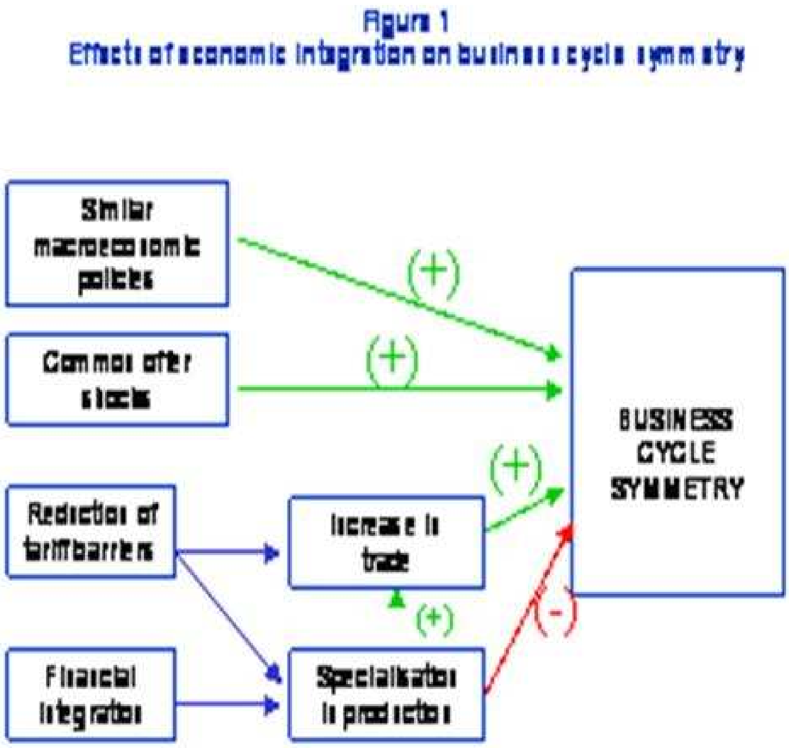

Table 1. Indices of asymmetry: Countries, 1981-1996

Greece	8.71
Spain	8.21
Portugal	7.38
Italy	7.32
United Kingdom	5.11
Luxembourg	4.32
Germany	2.81
Belgium	2.52
Ireland	2.12
Denmark	2.04
Holland	1.98
France	0.78

Map 1. Indices of asymmetry. 1981-1996

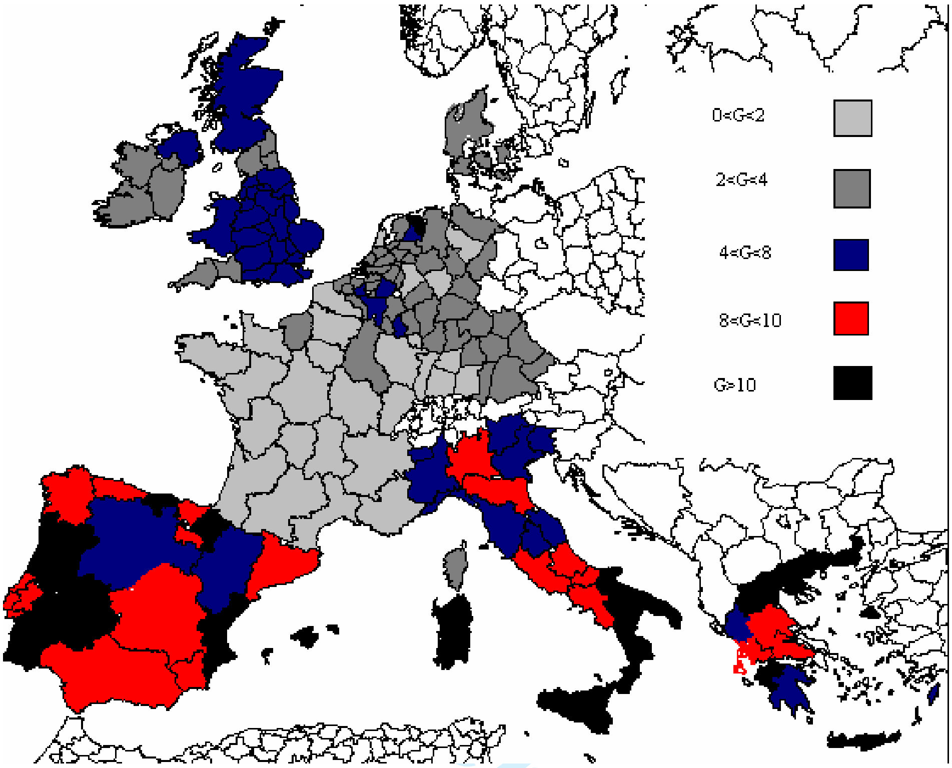

Table 2. Spatial autocorrelation tests

Variables	*Moran I*	*Geary C*
LASIM	9.40[a]	-8.50[a]
LESPEG	6.71[a]	-6.18[a]
LESPECI	4.48[a]	-4.34[a]
LAGRI	6.42[a]	-6.41[a]

Note: Null hypothesis rejected at significance level [a]α=0.01.

Table 3. Estimation results

	[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**
	(OLS)	**(ML-SER)**	**(OLS)**	**(ML-SER)**	**(OLS)**	**(ML-SER)**
Constant	1.20^{a} (0.16)	0.43^{a} (0.14)	1.50^{a} (0.08)	0.50^{a} (0.11)	1.46^{a} (0.09)	0.47^{a} (0.11)
LESPEG	0.26^{a} (0.07)	0.14^{a} (0.05)	0.33^{a} (0.06)	0.15^{a} (0.04)	0.39^{a} (0.05)	0.19^{a} (0.04)
LESPECI	0.18^{c} (0.10)	0.11^{c} (0.06)	0.19^{b} (0.10)	0.11^{c} (0.06)		
LAGRI	0.18^{b} (0.08)	0.05 (0.06)				
λ		0.66^{a} (0.06)		0.67^{a} (0.06)		0.68^{a} (0.06)
R^2-adj.	0.39	(*)	0.36	(*)	0.34	(*)
AIC	206.56	150.00	209.07	148.81	211.11	149.98
LIK	-99.28	-69.98	-101.54	-70.40	-103.55	-71.99
Kiefer-Salmon	4.17		3.54		3.28	
Breusch-Pagan	1.73	2.65	1.14	0.98	0.87	0.42
I-MORAN	7.01^{a}		7.14^{a}		6.89^{a}	
LM-ERR	0.77	0.25	0.35	0.24	1.76	0.15
LM-LAG	10.46^{a}		12.06^{a}		15.38^{a}	

Notes: Estimated standard errors are in parenthesis.
Null hypothesis rejected at significance level $^{a}\alpha$=0.01, $^{b}\alpha$=0.05, $^{c}\alpha$=0.10.
OLS: Ordinary least squares.
ML-SER: Maximum likelihood estimation with spatial error autocorrelation.
λ: Spatial autocorrelation coefficient.
(*) The presence of spatial autocorrelation means the adjusted determination coefficient, R^2-adj., is inadequate for determining the goodness of fit, and so, as is usual in the literature, we calculated Akaike's information criterion (AIC) and the maximum value of the likelihood function (LIK) for each of the estimated models.

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Appendix 1

1.1. Values of the indicator of asymmetry. 1981-1996

NUTS	CODE	DENOMINATION	G_i
	BEL	**BELGIQUE-BELGIË**	2.5155
1	BE1	Bruxelles/Brussels	3.1161
1	BE2	Vlaams Gewest	2.4390
2	be21	Antwerpen	2.6911
2	be22	Limburg	4.6669
2	be23	Oost-Vlaanderen	2.3319
2	be24	Vlaams Brabant	3.5199
2	be25	West-Vlaanderen	3.3089
1	BE3	Région Wallonne	2.9633
2	be31	Brabant Wallon	4.4170
2	be32	Hainaut	3.1840
2	be33	Liège	2.8586
2	be34	Luxembourg (Be)	2.6899
2	be35	Namur	4.5589
	DIN	**DENMARK**	2.0408
	ALE	**DEUTSCHLAND**	2.8143
1	DE1	Baden-Württemberg	1.7197
2	de11	Stuttgart	2.4274
2	de12	Karlsruhe	1.5365
2	de13	Freiburg	1.5187
2	de14	Tübingen	1.4322
1	DE2	Bayern	2.2899
2	de21	Oberbayern	2.6395
2	de22	Niederbayern	2.0888
2	de23	Oberpfalz	2.2055
2	de24	Oberfranken	2.1493
2	de25	Mittelfranken	2.3721
2	de26	Unterfranken	2.6647
2	de27	Schwaben	2.3440
1	DE5	Bremen	2.5289
1	DE6	Hamburg	2.2926
1	DE7	Hessen	2.2571
2	de71	Darmstadt	2.8192
2	de72	Giessen	3.7151
2	de73	Kassel	3.8802
1	DE9	Niedersachsen	2.1154
2	de91	Braunschweig	2.5022
2	de92	Hannover	1.9890
2	de93	Lüneburg	2.1138
2	de94	Weser-Ems	2.1438
1	DEA	Nordrhein-Westfalen	1.9551
2	dea1	Düsseldorf	1.6414
2	dea2	Köln	2.8950
2	dea3	Münster	2.5479
2	dea4	Detmold	2.5318
2	dea5	Arnsberg	1.6186
1	DEB	Rheinland-Pfalz	2.5726
2	deb1	Koblenz	2.5718
2	deb2	Trier	2.3898

2	deb3	Rheinhessen-Pfalz	2.7748
1	DEC	Saarland	1.9420
1	DEF	Schleswig-Holstein	3.1662
	GRE	**GREECE**	8.7133
1	GR1	Voreia Ellada	10.6621
2	gr11	Anatoliki Makedonia, Thraki	24.3479
2	gr12	Kentriki Makedonia	10.0632
2	gr13	Dytiki Makedonia	10.8695
2	gr14	Thessalia	9.8042
1	GR2	Kentriki Ellada	8.2058
2	gr21	Ipeiros	6.4876
2	gr22	Ionia Nisia	9.6958
2	gr23	Dytiki Ellada	12.6243
2	gr24	Sterea Ellada	9.1430
2	gr25	Peloponnisos	6.7764
1	GR3	Attiki	8.6614
1	GR4	Nisia Agaiou, Kriti	10.7268
2	gr41	Voreio Aigaio	18.5636
2	gr42	Notio Aigaio	5.7485
2	gr43	Kriti	16.0925
	ESP	**SPAIN**	8.2138
1	ES1	Noroeste	9.5056
2	es11	Galicia	9.8025
2	es12	Asturias	9.9381
2	es13	Cantabria	11.8079
1	ES2	Noreste	7.9961
2	es21	País Vasco	8.9409
2	es22	Navarra	10.7497
2	es23	La Rioja	8.8209
2	es24	Aragón	7.7462
1	ES3	Madrid	9.3293
1	ES4	Centro	7.3716
2	es41	Castilla y León	5.6718
2	es42	Castilla-La Mancha	9.9619
2	es43	Extremadura	14.8316
1	ES5	Este	9.5237
2	es51	Cataluña	9.6431
2	es52	Comunidad Valenciana	10.3227
2	es53	Islas Baleares	11.8629
1	ES6	Sur	8.1639
2	es61	Andalucía	8.4573
2	es62	Murcia	8.7021
1	ES7	Canarias	8.2651
	FR	**FRANCE**	0.7836
1	FR1	Île de France	1.0579
1	FR2	Bassin Parisien	1.0531
2	fr21	Champagne-Ardenne	2.0149
2	fr22	Picardie	1.5998
2	fr23	Haute-Normandie	3.5255
2	fr24	Centre	1.0015
2	fr25	Basse-Normandie	1.4533
2	fr26	Bourgogne	1.2750
1	FR3	Nord-Pas de Calais	1.0591

1	FR4	Est	1.0675
2	fr41	Lorraine	1.2583
2	fr42	Alsace	1.7161
2	fr43	Franche-Comté	1.5996
1	FR5	Ouest	1.0830
2	fr51	Pays de la Loire	1.2330
2	fr52	Bretagne	1.1501
2	fr53	Poitou-Charentes	1.4113
1	FR6	Sud-Ouest	0.7246
2	fr61	Aquitanie	0.8758
2	fr62	Midi-Pyrenees	0.8024
2	fr63	Limousin	1.6467
1	FR7	Centre-Est	0.9598
2	fr71	Rhône-Alpes	0.9681
2	fr72	Avergne	1.5924
1	FR8	Méditerranée	0.8427
2	fr81	Languedoc-Roussillon	1.9085
2	fr82	Provence-Alpes-Côte d'Azur	0.7621
2	fr83	Corse	2.1905
	IRL	**IRELAND**	2.1155
	ITA	**ITALY**	7.3245
1	IT1	Nord Ovest	7.1959
2	it11	Piemonte	7.1974
2	it12	Valle d'Aosta	7.7593
2	it13	Liguria	8.0878
1	IT2	Lombardia	6.8484
1	IT3	Nord Est	6.2508
2	it31	Trentino-Alto Adige	7.6703
2	it32	Veneto	6.1688
2	it33	Friuli-Venezia Giulia	6.1833
1	IT4	Emilia-Romagna	6.0335
1	IT5	Centro	6.8704
2	it51	Toscana	6.6962
2	it52	Umbria	7.3688
2	it53	Marche	7.6124
1	IT6	Lazio	9.9281
1	IT7	Abruzzo-Molise	8.9217
2	it71	Abruzzo	8.9273
2	it72	Molise	9.9018
1	IT8	Campania	9.4576
1	IT9	Sud	9.4963
2	it91	Puglia	10.8839
2	it92	Basilicata	10.3308
2	it93	Calabria	10.8282
1	ITA	Sicilia	11.0553
1	ITB	Sardegna	10.8292
	LUX	**LUXEMBOURG**	4.3276
	NL	**NEDERLAND**	1.9799
1	NL1	Noord-Nederland	10.7767
2	nl11	Groningen	31.8297
2	nl12	Friesland	3.8479
2	nl13	Drenthe	5.0101
1	NL2	Oost-Nederland	2.7084

1	NL3	West-Nederland	2.1484
2	nl31	Utrecht	2.9452
2	nl32	Noord-Nederland	1.9920
2	nl33	Zuid-Holland	2.9871
2	nl34	Zeeland	4.8255
1	NL4	Zuid-Nederland	2.0844
2	nl41	Noord-Brabant	2.2356
2	nl42	Limburg (NL)	2.3659
	POR	**PORTUGAL**	7.3861
1	PT1	Continente	7.1232
2	pt11	Norte	12.5350
2	pt12	Centro	22.6737
2	pt13	Lisboa e Vale do Tejo	9.8284
2	pt14	Alentejo	54.9982
2	pt15	Algarve	32.5539
	UK	**UNITED KINGDOM**	5.1123
1	UKC	North East	2.5172
1	UKD	North West	2.7318
1	UKE	Yorkshire and the Humber	2.0598
1	UKF	East Midlands	5.0456
1	UKG	West Midlands	5.0725
1	UKH	Eastern	3.2754
1	UKJ	South East	4.3301
1	UKK	South West	3.9639
1	UKL	Wales	4.5627
1	UKM	Scotland	4.7278
1	UKN	Northern Ireland	4.4319

Appendix 2

2.1. Territorial units making up the sample on which the econometric analysis is conducted

Bruxelles/Brussels
Antwerpen
Limburg
Oost-Vlaanderen
Vlaams Brabant
West-Vlaanderen
Brabant Wallon
Hainaut
Liège
Luxembourg (Be)
Namur
Danmark
Anatoliki Makedonia, Thraki
Kentriki Makedonia
Dytiki Makedonia
Thessalia
Ipeiros
Ionia Nisia
Dytiki Ellada
Sterea Ellada
Peloponnisos
Attiki
Voreio Aigaio
Notio Aigaio
Kriti
Galicia
Asturias
Cantabria
País Vasco
Navarra
La Rioja
Aragón
Madrid
Castilla y León
Castilla-La Mancha
Extremadura
Cataluña
Comunidad Valenciana
Islas Baleares
Andalucía
Murcia
Canarias
Île de France
Champagne-Ardenne

Picardie
Haute-Normandie
Centre
Basse-Normandie
Bourgogne
Nord-Pas de Calais
Lorraine
Alsace
Franche-Comté
Pays de la Loire
Bretagne
Poitou-Charentes
Aquitanie
Midi-Pyrenees
Limousin
Rhône-Alpes
Avergne
Languedoc-Roussillon
Provence-Alpes-Côte d'Azur
Corse
Ireland
Piemonte
Valle d'Aosta
Liguria
Lombardia
Trentino-Alto Adige
Veneto
Friuli-Venezia Giulia
Emilia-Romagna
Toscana
Umbria
Marche
Lazio
Abruzzo
Molise
Campania
Puglia
Basilicata
Calabria
Sicilia
Sardegna
Luxembourg
Norte
Centro
Lisboa e Vale do Tejo
Alentejo
Algarve

2.2. Sectors

The 19 sectors in which REGIO breaks down regional employment are:

1. Agriculture

2. Energy products
3. Manufactured products
4. Ferrous and non-ferrous metals
5. Non-metallic minerals
6. Chemicals
7. Metal products, machinery and electrical equipment
8. Transport material
9. Food, drinks and tobacco
10. Textile, shoes and leather
11. Paper and graphic arts
12. Other industrial products

13. Construction

14. Retail and wholesale trade and repair of motor vehicles
15. Transport and communications
16. Market services
17. Credit and insurance institutions
18. Other market services
19. Non-market services